CLAIMS:

What is claimed is:

1. A method comprising:

recording a plurality of write commands in a forward journal;

generating a virtual recovery mapping object from the plurality of write commands, wherein the virtual recovery mapping object maps logical addresses into physical storage addresses;

generating a plurality of backward moves from the write commands, wherein the backward moves correspond to reverse changes that reverse the effect of the plurality of write commands;

correlating the virtual recovery mapping object with the plurality of backward moves so that the virtual recovery mapping object maps logical addresses to corresponding backward moves from the plurality of backward moves.

2. The method of claim 1, wherein the write commands are atomic write commands.

3. The method of claim 1, further comprising:

applying the plurality of write commands to a mirror-in-the-middle (MIM).

4. The method of claim 3, wherein the virtual recovery mapping object maps a set of logical address ranges

representing physical extents of data in the forward journal into physical addresses of the physical extents.

5. The method of claim 3, wherein the virtual recovery mapping object maps a set of logical address ranges representing physical extents of data in the mirror-in-the-middle (MIM) into physical addresses of the physical extents.

6. The method of claim 3, further comprising:

copying an extent of data corresponding to each of the plurality of backward moves from the mirror-in-the-middle (MIM) into a backward journal; and

generating, in each backward move, a pointer to the extent of data in the backward journal corresponding to that backward move.

7. The method of claim 6, wherein the virtual recovery mapping object is a tree data structure having tree nodes and physical extent lists, the physical extent lists represent extents of data stored in the backward journal.

8. The method of claim 7, wherein the tree nodes represent logical address ranges.

9. The method of claim 8, wherein the logical address ranges correspond to physical address ranges located on the mirror-in-the-middle.

10. The method of claim 8, wherein the logical address ranges correspond to physical address ranges stored in extents of data in the backward journal.

11. The method of claim 6, wherein each of the write commands contains a logical address range, and generating the plurality of backward moves includes identifying at least a portion of the logical address range that is mapped into an extent of data in the backward journal and generating a backward move corresponding to the at least a portion of the logical address range.

12. The method of claim 3, further comprising:

in response to applying the plurality of write commands to the mirror-in-the-middle, removing the plurality of write commands from the forward journal.

13. The method of claim 1, wherein the forward journal includes a circular queue.

14. The method of claim 1, wherein the plurality of backward moves is generated in response to a system event.

15. The method of claim 1, wherein the plurality of backward moves is generated at least one specified time.

16. The method of claim 1, wherein the plurality of backward moves is generated in response to insufficient space being available for the forward journal.

17. The method of claim 1, wherein the virtual recovery mapping object contains an indexed data structure that is indexed on a first set of logical address ranges.

18. The method of claim 17, further comprising:

in response to the virtual recovery mapping object exceeding a pre-determined size in memory, re-indexing the virtual recovery mapping object to be index on a second set of logical address ranges.

19. The method of claim 1, further comprising:

updating the virtual recovery mapping object in response to a second plurality of write commands.

20. The method of claim 1, further comprising:

generating additional backward moves in response to a second plurality of write commands.

21. The method of claim 1, further comprising:

updating a second virtual recovery mapping object using the plurality of backward moves.

22. A computer program product in a computer readable medium comprising functional descriptive material that, when executed by a computer, enables the computer to perform acts including:

recording a plurality of write commands in a forward journal;

generating a virtual recovery mapping object from the plurality of write commands, wherein the virtual

recovery mapping object maps logical addresses into physical storage addresses;

generating a plurality of backward moves from the write commands, wherein the backward moves correspond to reverse changes that reverse the effect of the plurality of write commands;

correlating the virtual recovery mapping object with the plurality of backward moves so that the virtual recovery mapping object maps logical addresses to corresponding backward moves from the plurality of backward moves.

23. The computer program product of claim 22, wherein the write commands are atomic write commands.

24. The computer program product of claim 22, comprising additional functional descriptive material that, when executed by the computer, enables the computer to perform acts including:

applying the plurality of write commands to a mirror-in-the-middle (MIM).

25. The computer program product of claim 24, wherein the virtual recovery mapping object maps a set of logical address ranges representing physical extents of data in the forward journal into physical addresses of the physical extents.

26. The computer program product of claim 24, wherein the virtual recovery mapping object maps a set of logical

address ranges representing physical extents of data in the mirror-in-the-middle (MIM) into physical addresses of the physical extents.

27. The computer program product of claim 24, comprising additional functional descriptive material that, when executed by the computer, enables the computer to perform acts including:

copying an extent of data corresponding to each of the plurality of backward moves from the mirror-in-the-middle (MIM) into a backward journal; and

generating, in each backward move, a pointer to the extent of data in the backward journal corresponding to that backward move.

28. The computer program product of claim 27, wherein the virtual recovery mapping object is a tree data structure having tree nodes and physical extent lists, the physical extent lists represent extents of data stored in the backward journal.

29. The computer program product of claim 28, wherein the tree nodes represent logical address ranges.

30. The computer program product of claim 29, wherein the logical address ranges correspond to physical address ranges located on the mirror-in-the-middle.

31. The computer program product of claim 29, wherein the logical address ranges correspond to physical address ranges stored in extents of data in the backward journal.

32. The computer program product of claim 27, wherein each of the write commands contains a logical address range, and generating the plurality of backward moves includes identifying at least a portion of the logical address range that is mapped into an extent of data in the backward journal and generating a backward move corresponding to the at least a portion of the logical address range.

33. The computer program product of claim 24, comprising additional functional descriptive material that, when executed by the computer, enables the computer to perform acts including:

in response to applying the plurality of write commands to the mirror-in-the-middle, removing the plurality of write commands from the forward journal.

34. The computer program product of claim 22, wherein the forward journal includes a circular queue.

35. The computer program product of claim 22, wherein the plurality of backward moves is generated in response to a system event.

36. The computer program product of claim 22, wherein the plurality of backward moves is generated at least one specified time.

37. The computer program product of claim 22, wherein the plurality of backward moves is generated in response to insufficient space being available for the forward journal.

38. The computer program product of claim 22, wherein the virtual recovery mapping object contains an indexed data structure that is indexed on a first set of logical address ranges.

39. The computer program product of claim 38, comprising additional functional descriptive material that, when executed by the computer, enables the computer to perform acts including:

in response to the virtual recovery mapping object exceeding a pre-determined size in memory, re-indexing the virtual recovery mapping object to be index on a second set of logical address ranges.

40. The computer program product of claim 22, comprising additional functional descriptive material that, when executed by the computer, enables the computer to perform acts including:

updating the virtual recovery mapping object in response to a second plurality of write commands.

41. The computer program product of claim 22, comprising additional functional descriptive material that, when executed by the computer, enables the computer to perform acts including:

generating additional backward moves in response to a second plurality of write commands.

42. The computer program product of claim 22, comprising additional functional descriptive material that, when executed by the computer, enables the computer to perform acts including:

updating a second virtual recovery mapping object using the plurality of backward moves.

43. A data management appliance comprising means for:

recording a plurality of write commands in a forward journal;

generating a virtual recovery mapping object from the plurality of write commands, wherein the virtual recovery mapping object maps logical addresses into physical storage addresses;

generating a plurality of backward moves from the write commands, wherein the backward moves correspond to reverse changes that reverse the effect of the plurality of write commands;

correlating the virtual recovery mapping object with the plurality of backward moves so that the virtual recovery mapping object maps logical addresses to corresponding backward moves from the plurality of backward moves.

44. The data management appliance of claim 43, wherein the write commands are atomic write commands.

45. The data management appliance of claim 43, comprising additional means for:

applying the plurality of write commands to a mirror-in-the-middle (MIM).

46. The data management appliance of claim 45, wherein the virtual recovery mapping object maps a set of logical address ranges representing physical extents of data in the forward journal into physical addresses of the physical extents.

47. The data management appliance of claim 45, wherein the virtual recovery mapping object maps a set of logical address ranges representing physical extents of data in the mirror-in-the-middle (MIM) into physical addresses of the physical extents.

48. The data management appliance of claim 45, comprising additional means for:

copying an extent of data corresponding to each of the plurality of backward moves from the mirror-in-the-middle (MIM) into a backward journal; and

generating, in each backward move, a pointer to the extent of data in the backward journal corresponding to that backward move.

49. The data management appliance of claim 48, wherein the virtual recovery mapping object is a tree data structure having tree nodes and physical extent lists, the physical extent lists represent extents of data stored in the backward journal.

50. The data management appliance of claim 49, wherein the tree nodes represent logical address ranges.

51. The data management appliance of claim 50, wherein the logical address ranges correspond to physical address ranges located on the mirror-in-the-middle.

52. The data management appliance of claim 50, wherein the logical address ranges correspond to physical address ranges stored in extents of data in the backward journal.

53. The data management appliance of claim 48, wherein each of the write commands contains a logical address range, and generating the plurality of backward moves includes identifying at least a portion of the logical address range that is mapped into an extent of data in the backward journal and generating a backward move corresponding to the at least a portion of the logical address range.

54. The data management appliance of claim 45, comprising additional means for:

in response to applying the plurality of write commands to the mirror-in-the-middle, removing the plurality of write commands from the forward journal.

55. The data management appliance of claim 43, wherein the forward journal includes a circular queue.

56. The data management appliance of claim 43, wherein the plurality of backward moves is generated in response to a system event.

57. The data management appliance of claim 43, wherein the plurality of backward moves is generated at least one specified time.

58. The data management appliance of claim 43, wherein the plurality of backward moves is generated in response to insufficient space being available for the forward journal.

59. The data management appliance of claim 43, wherein the virtual recovery mapping object contains an indexed data structure that is indexed on a first set of logical address ranges.

60. The data management appliance of claim 59, comprising additional means for:

in response to the virtual recovery mapping object exceeding a pre-determined size in memory, re-indexing

the virtual recovery mapping object to be index on a second set of logical address ranges.

61. The data management appliance of claim 43, comprising additional means for:

updating the virtual recovery mapping object in response to a second plurality of write commands.

62. The data management appliance of claim 43, comprising additional means for:

generating additional backward moves in response to a second plurality of write commands.

63. The data management appliance of claim 43, comprising additional means for:

updating a second virtual recovery mapping object using the plurality of backward moves.